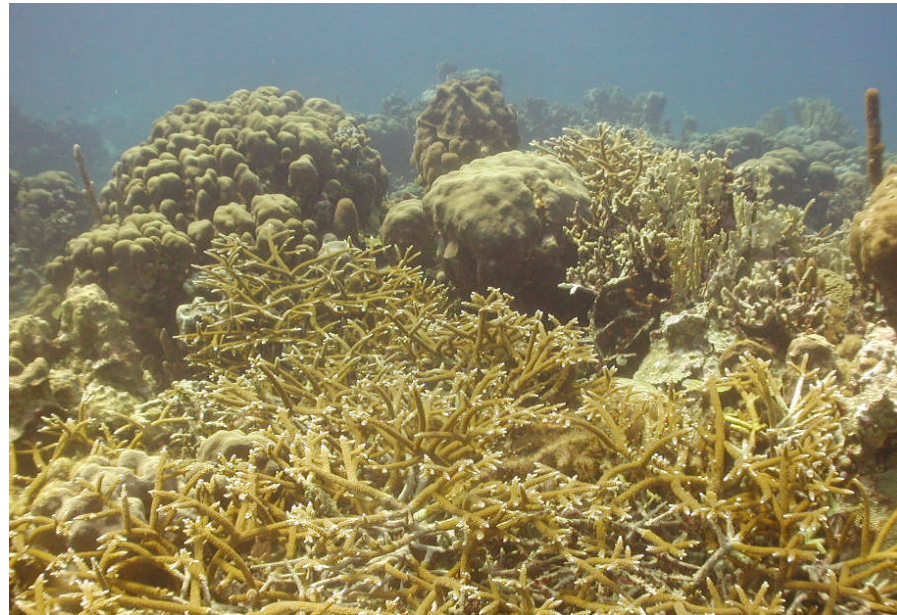


Coral reefs lecture outline

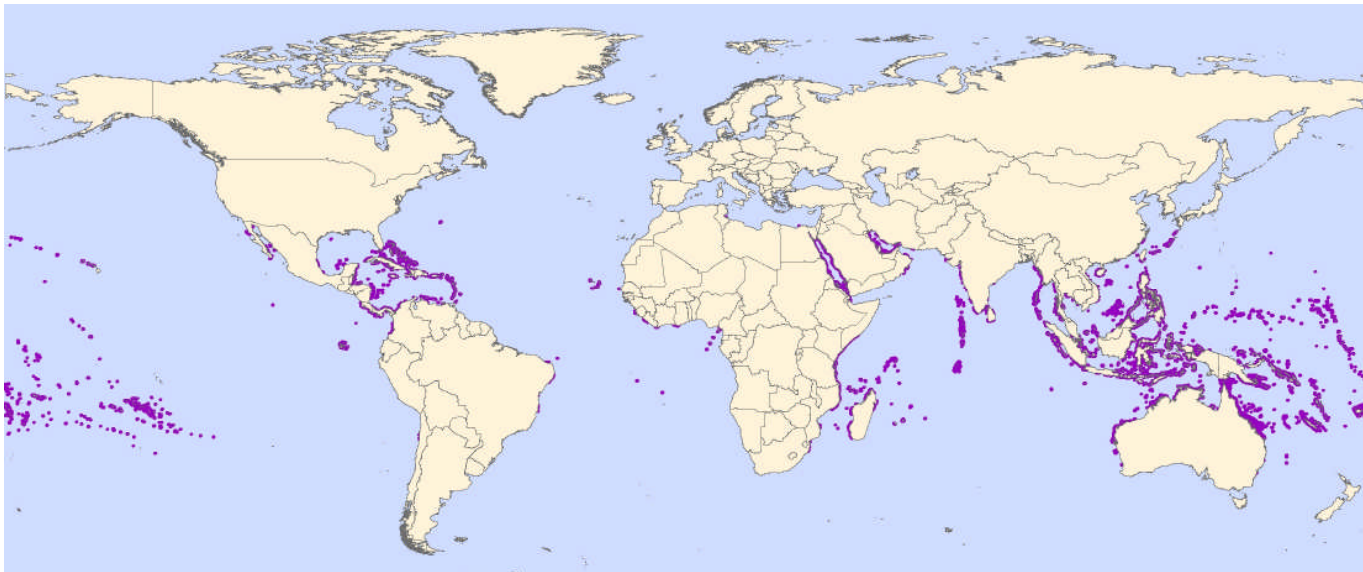
- Basic ecology, global distribution, and structure of coral reefs
- Seagrass beds and Mangrove forests
- Ecosystem goods and services provided by coral reefs
- Threats to coral reefs



(Courtesy: John Bruno)

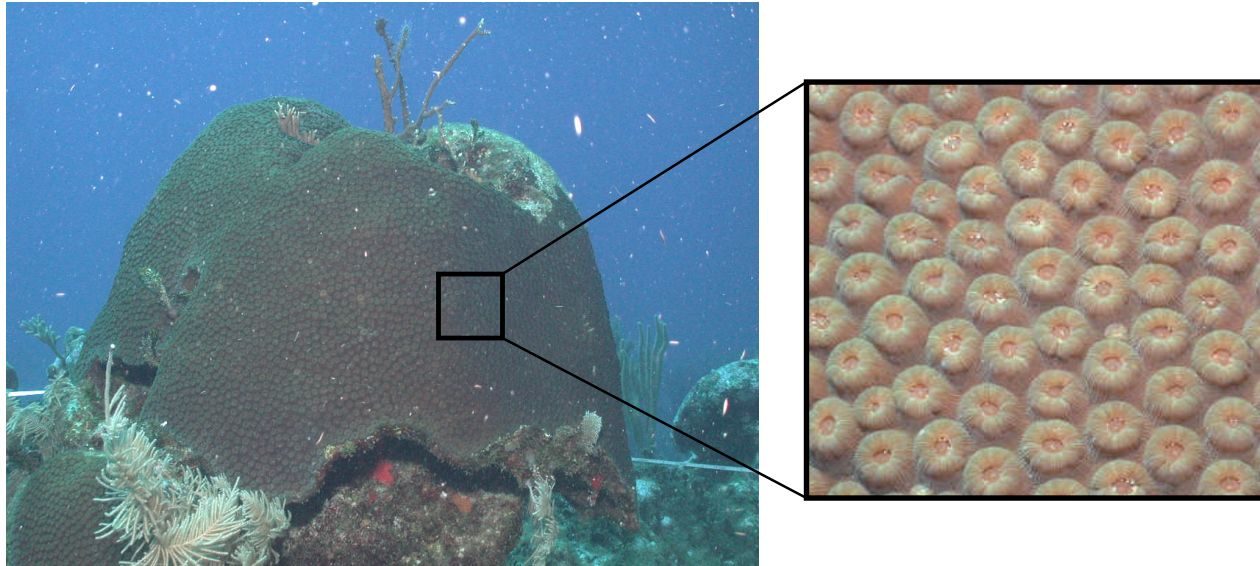
Global distribution of coral reefs

Reef-building corals require clear, warm waters, with plenty of light and minimal nutrients



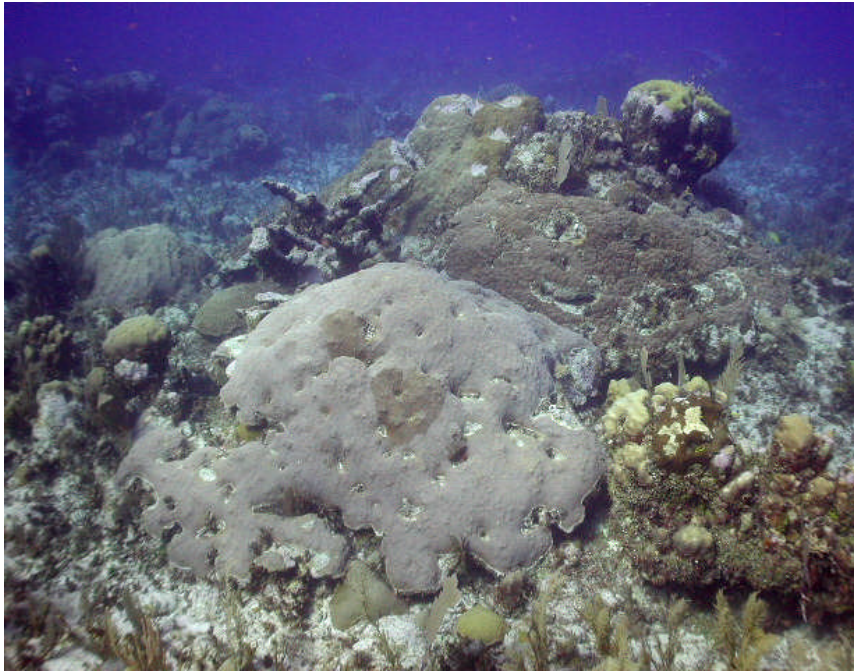
Global distribution of coral reefs
(Courtesy: Elizabeth Selig)

Biology of corals

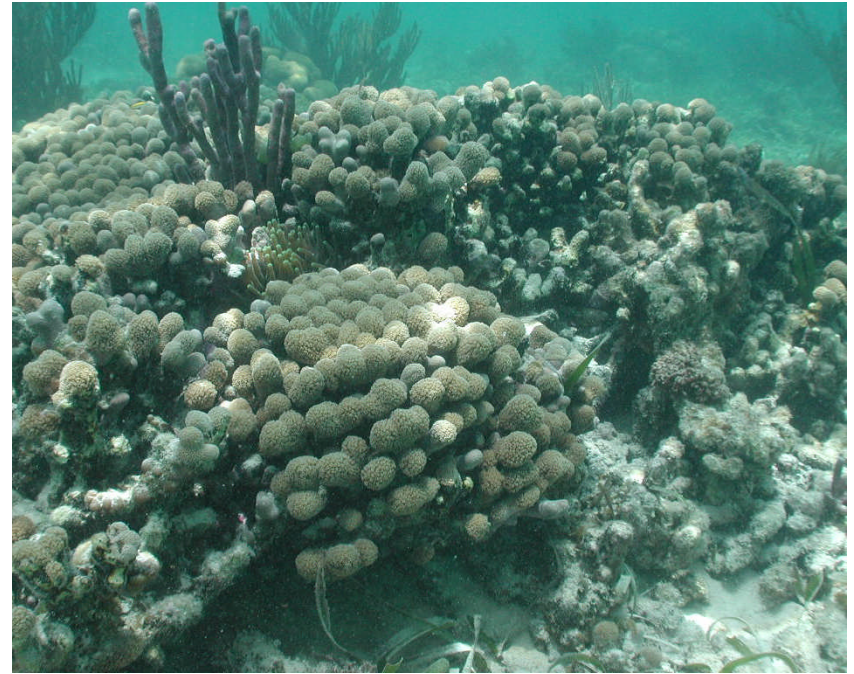


A coral colony and a close up image of coral polyps
(Courtesy: John Bruno)

Some examples of tropical coral morphology



Boulder corals
(Courtesy: John Bruno)



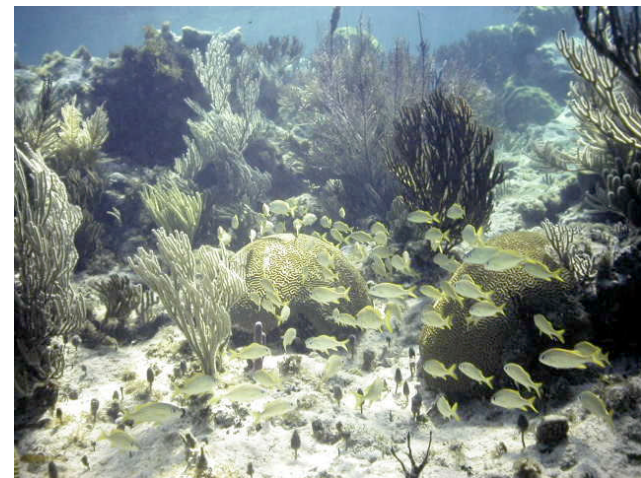
Branching corals
(Courtesy: John Bruno)

Reef zonation: the backreef



the backreef zone

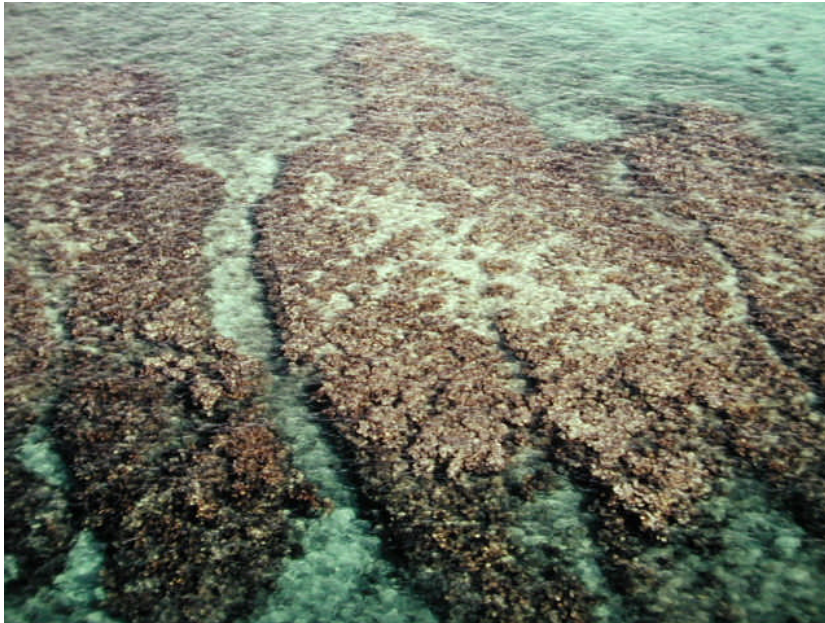
Aerial photograph of a
Mexican reef
(Courtesy: Conrad Neumann)



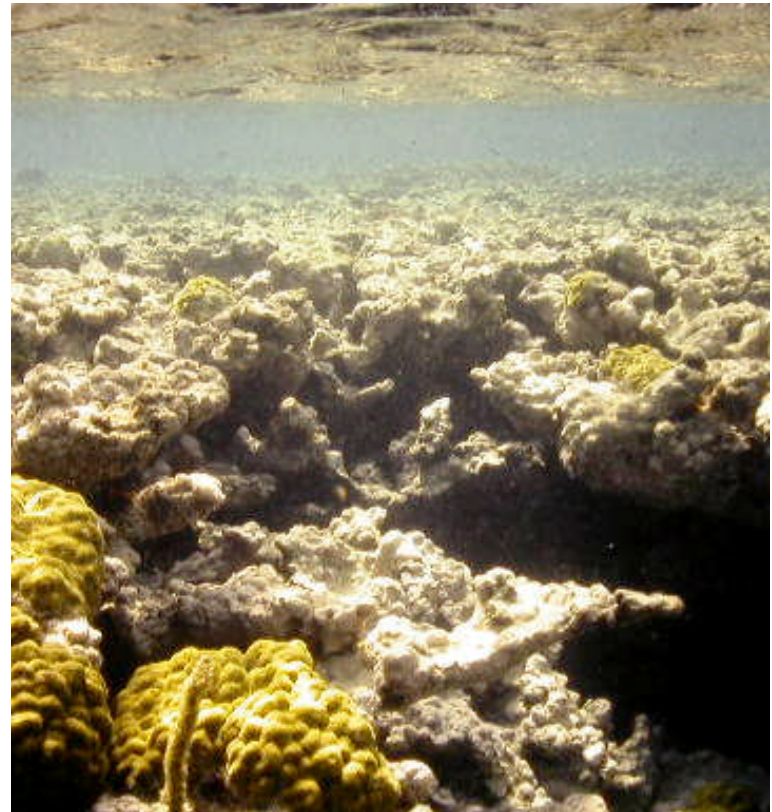
A backreef patch reef
(Courtesy: Conrad Neumann)

Reef zonation: the reef crest

- high energy environment
- dominated by coralline algae



A reef crest-note surge channels
(Courtesy: Conrad Neumann)



A reef crest
(Courtesy: Conrad Neumann)

Reef zonation: the forereef



Elkhorn coral
(Courtesy: John Bruno)



Staghorn coral
(Courtesy: John Bruno)

Who lives on a reef?

Coral reefs are inhabited by thousands of species including:

Fish

Sea turtles

Sharks and rays

Urchins and star fish

Worms

Crabs and lobster

Snails

Clams, scallops, and barnacles

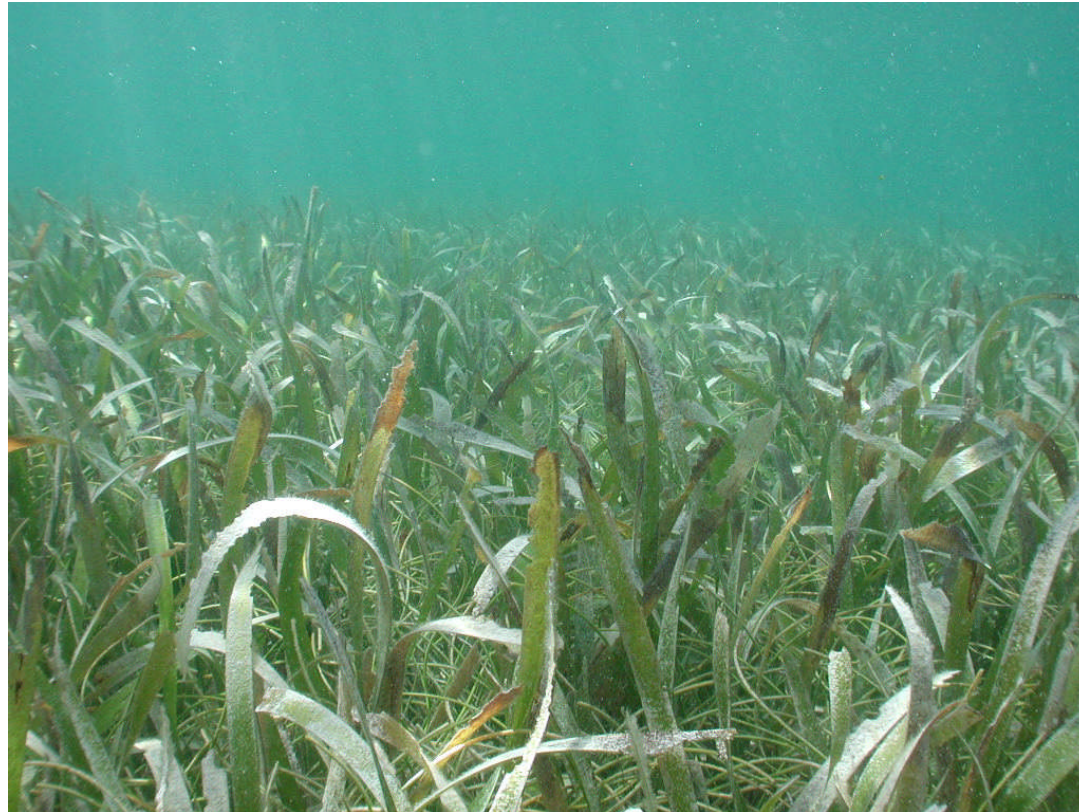
Sea slugs

Algae

Sponges

Soft corals

Seagrass beds



A backreef seagrass bed
(Courtesy: John Bruno)

Mangrove forests



A mangrove forest
(Courtesy: John Bruno)

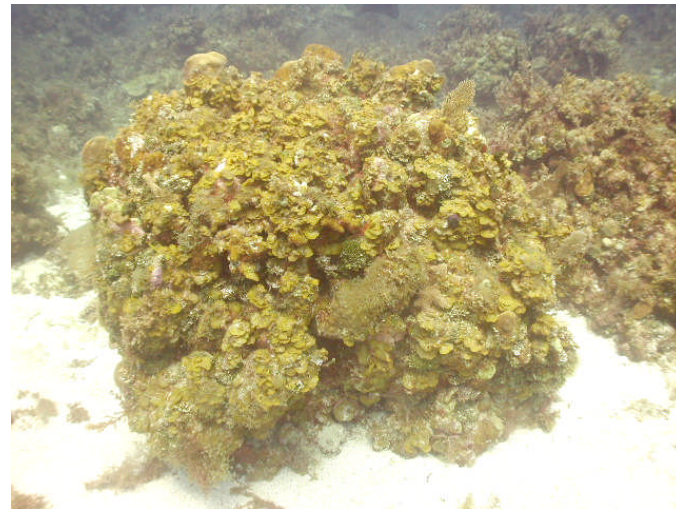
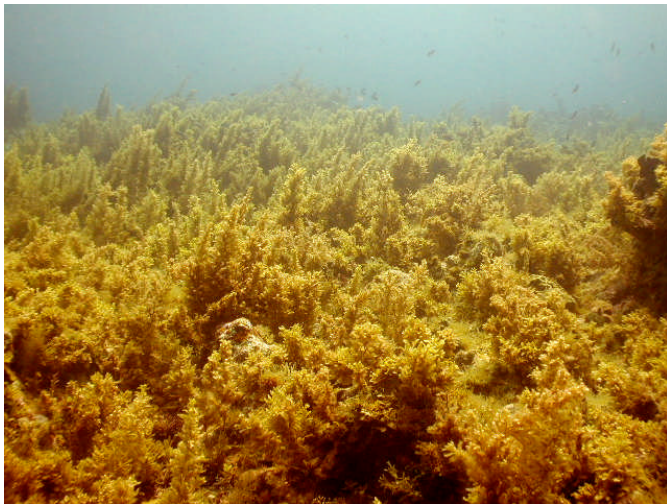
Ecosystem goods and services provided by reefs

- **Storm buffers**
- **Tourism**
 - \$1.6 billion/year in the Florida Keys
 - \$8.9 billion/year in the Caribbean
- **Fishing**
 - Coral reef fisheries account for:
 - 10% of fish harvest in tropical countries
 - 25% of fish catch in developing countries
 - 90% of protein consumed by people on Pacific islands
- **Biodiversity and bioprospecting**

Coral reef decline

Some of the recent changes to coral reefs:

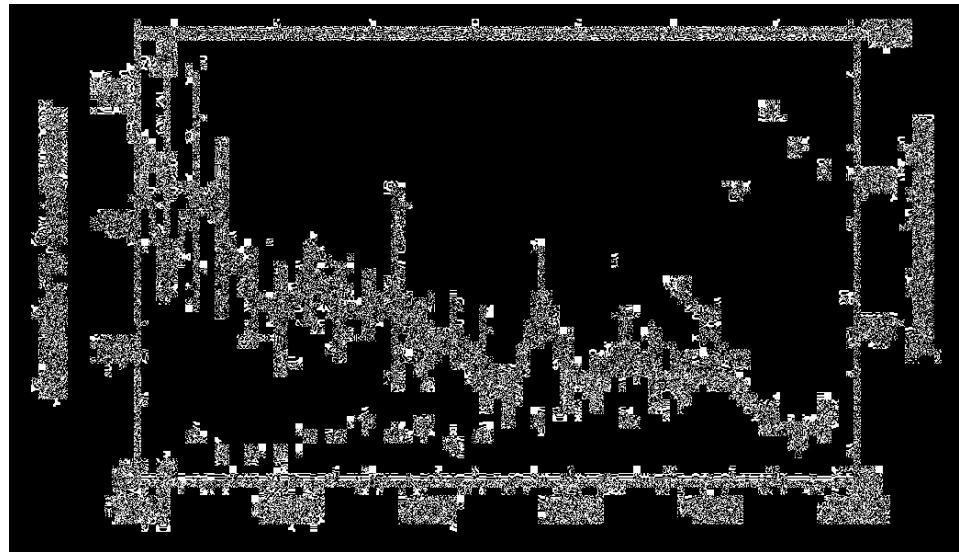
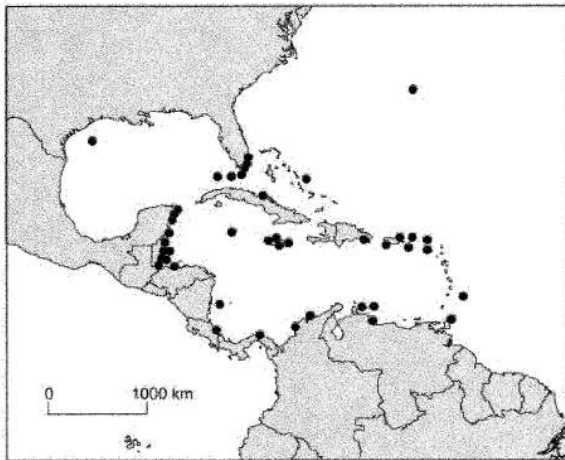
- decline in coral cover and reef heterogeneity
- loss of large vertebrates
- overexploitation of fish and invertebrates
- increase in macroalgal cover



A Jamaican reef dominated by macroalgae
(Courtesy: John Bruno)

Caribbean coral reef decline

On average, coral cover in the Caribbean decreased from 60% to 10% over the last 20 years.



Meta-analysis of 263 Caribbean sites from 65 studies
(Gardener et al. 2003)

Threats to coral reef health: overfishing



A Jamaican fish trap: few large fish remain on the reef and the catch is usually fish more suitable for an aquarium than a dinner plate.
(Courtesy: John Bruno)

Threats to coral reef health: disease outbreaks



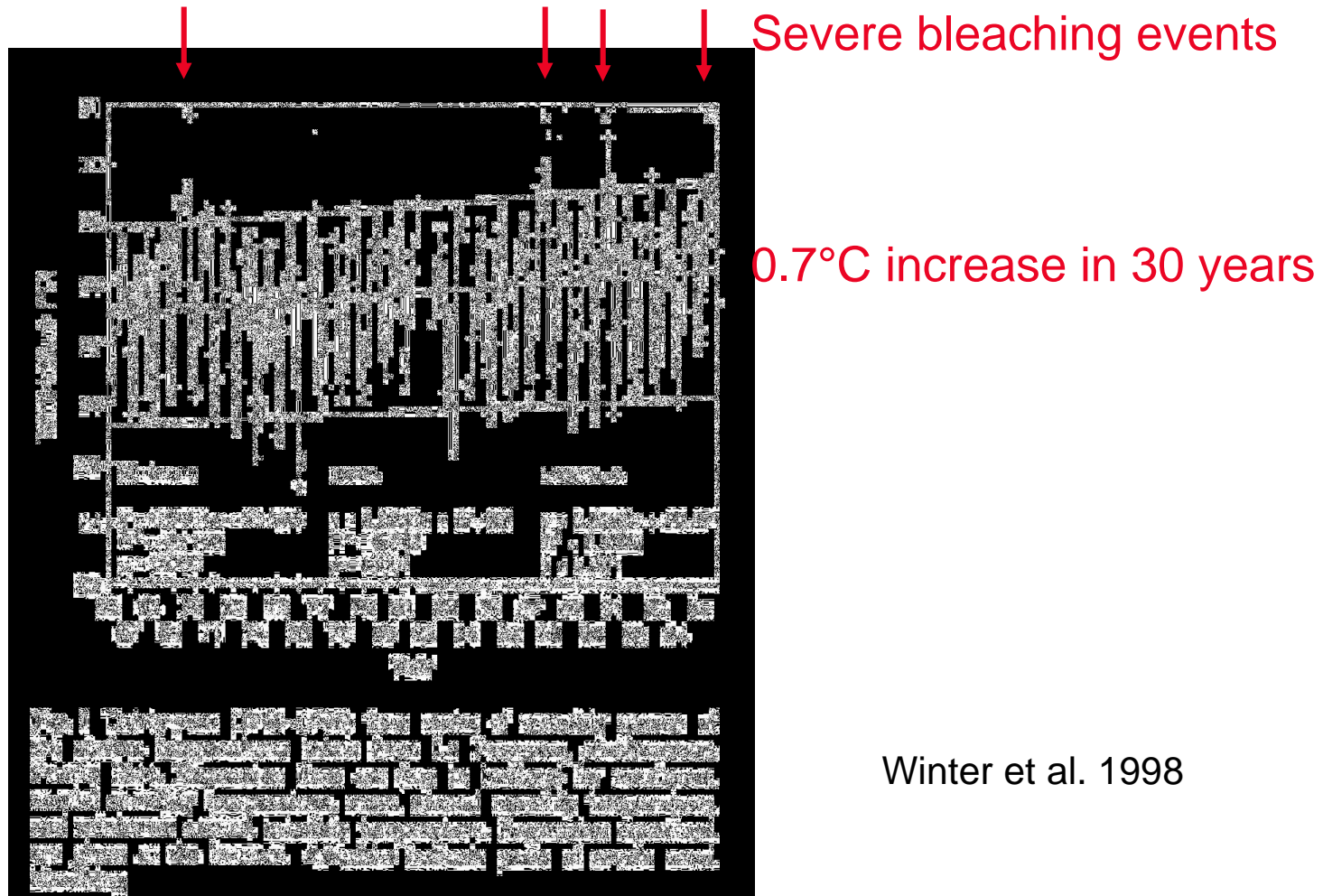
A boulder coral infected with yellow band disease-caused by a bacterial pathogen
(Courtesy: John Bruno)

A sea fan with aspergillois-a fungal infection
(Courtesy: John Bruno)



Threats to coral reef health: increasing ocean temperature

Increases in Caribbean Sea Surface Temperature (Puerto Rico 1966-1995)



Threats to coral reef health: small scale threats

- anchors
- ship groundings
- divers and snorkelers
- coastal development
- collecting



A snorkeler standing on a coral
(Courtesy: Conrad Neumann)

Mitigating the threats to coral reef health



Are there any realistic solutions to managing coral reefs?

There are several causal factors that operate at different spatial scales.

What are some potential management strategies?